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Patents Form 1/77

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22JUN98 E369908-1 D00032
P01/7700 25.00 - 9813371.3

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

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2. Your reference JCV/JME/VC/Powell 1

2. Patent application number
(The Patent Office will fill in this part) 22 JUN 1998 **9813371.3**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

George Leonard POWELL
15 Laura Drive
HEXTABLE
KENT BR8 7RX
UNITED KINGDOM

Patents ADP number *(if you know it)* 5667027001

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

ANTI-COLLISION TAG APPARATUS AND SYSTEM

5. Name of your agent *(if you have one)* J.C.VAUFROUARD of ELKINGTON AND FIFE

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

ELKINGTON AND FIFE
PROSPECT HOUSE
8 PEMBROKE ROAD
SEVENOAKS
KENT
TN13 1XR

Patents ADP number *(if you know it)* 67004

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of Filing *(day/month/year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of Filing *(day/month/year)*
	#

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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer "Yes" if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.

See note (d))

NO

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	6
Claim(s)	2
Abstract	1
Drawing(s)	2

10. If you are also filing any of the following, state how many against each item.

Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	0
Request for preliminary examination and search *(Patents Form 9/77)*	0
Request for substantive examination *(Patents Form 10/77)*	0
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature J. Vaufrouard Date 22 JUNE 1998

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr J.C. VAUFROUARD
01732 458881

Anti-Collision Tag Apparatus and System

This invention relates to radio frequency identification (RFID) apparatus comprising a reader/writer (later referred to simply as the 'reader') and transponders (tags) such that 2 or more transponders are capable of operating simultaneously in the same field so that information in the form of data bits may be received from the tags without corruption. This has come to be known as anti-collision.

Such apparatus forms the basis of a radio frequency tagging system where the number of tags within the field that may be read is limited only by the number of unique combinations of bits used to define a code to identify each tag.

Common disadvantages with systems known in the art include the necessity to either decrypt overlaying data caused by multiple tags 'talking' at the same time or the reliance on random transmissions to separate signals in the time domain or the necessity to use a field beam to isolate individual tags.

The invention seeks to provide a comparatively simple apparatus and system which avoids one or more of the above mentioned disadvantages.

According to one aspect of the invention, there is provided a Radio frequency tag identification apparatus comprising a radio frequency modulation receiver/transmitter, an antenna array, a radio frequency transponder, an external data communication port and an energising source.

According to another aspect of the invention, there is provided a radio frequency tag identification system comprising a receiver/transmitter and n transponders which are adapted to start communication at the same time and to be simultaneously interrogated and progressively eliminated from interrogation.

Previous inventions have mostly tried to incorporate some means to talk to single tags or make use of extremely complicated algorithms to decrypt overlaying data. The present invention is directed to an alternative way of interrogating multiple tags.

The invention will now be described, by way of example only, with reference to the accompanying Figures in which :-

Figure 1 is a data bit stream generated by a system in accordance with the invention,

Figure 2 is another data bit stream generated by a system in accordance with the invention,

Figure 3 is a block diagram of a reader suitable for use in a system constructed in accordance with the invention, and

Figure 4 is a block diagram of a transponder suitable for use in a system constructed in accordance with the invention.

In an embodiment of the invention, all the tags are requested to start communicating at

the same time, forming a 'collision' and are all simultaneously interrogated and progressively eliminated. Communications from the tags are synchronised by, in this case, a start search pattern, but may be by any other form of synchronisation. Tags that do not receive a valid start search pattern do not send data at all.

The invention might be better thought of as Synchronised Collision. It is normal for a reader to communicate to the tag using 100% modulation of the field. To start a search pattern, the reader transmits a data pattern called a 'start search pattern'. This is understood by all tags as a start search command. There is another pattern known as a 'new sweep pattern'. A search will generally consist of as many sweeps as there are tags in the field, if the number of tags in the field is known, otherwise an additional sweep is required to confirm that there are no remaining tags in the field. The above patterns in this example are detected by their duration but may be any compatible distinguishable pattern.

Tags are only allowed to participate in a search if they have received a 'start search pattern'. This, among other things, prevents late arrivals from disrupting the search. After the valid reception of a start search pattern, the tag is said to go active. The reader next transmits the interrogation pulse sequence. In this embodiment, the length of the pulse determines the binary value of the interrogation pulse, but alternative encoding schemes such as pulse code modulation may be used. The method of modulation is amplitude modulation, however, alternative methods such as phase modulation may be used.

As the pulse duration increases, it passes through a period in time called the 0 modulation window (MW-0) in which all active tags which have a 0 in the first bit position must reply by turning on their modulator thus modulating the field. In the absence of a detectable response the reader will continue the duration of the pulse. As the pulse duration increases it passes through another period in time called the 1 modulation window (MW-1) in which all active tags which have a 1 in the first bit position must reply by turning on their modulator thus modulating the field.

As a consequence, a tag will always be asked if its next bit is a 0 before it is asked if its next bit is a 1. Where more than one tag replies by modulating the field at the same time, the modulation to the field is increased. Logic within the reader will normally, upon the detection of modulation appearing in a MW-0 window, not continue the pulse to transmit a MW-1 modulation window. Where the MW-1 modulation window is not transmitted, any tag that has a 1 in that bit position is programmed to go quiescent until a 'new sweep pattern' is received.

The reader transmits the next interrogation pulse and so on. In this way the reader can conduct a highly efficient binary search, such that it need only transmit n pulses, albeit of different duration, where the tag bit length is n bits.

When a tag has successfully been interrogated to the end and uniquely identified, the reader may write data to it (assuming the tag has EEROM or EPROM). Once read, the tag may be preprogrammed to remain silent until either the field is removed or it receives a new 'start search pattern'. The reader next transmits a 'new sweep pattern' and

continues reading and eliminating tags until none remain. The 'new sweep pattern' wakes any tag in the 'quiescent state' which has been eliminated, but not read, from a previous sweep allowing it to participate in the next sweep. Each sweep will normally identify a unique tag hence there will usually be as many sweeps as there are tags in the field, if the number of tags in the field is known, otherwise an additional sweep is required to confirm that there are no remaining tags in the field.

Reader Logic

The reader begins by sending a start search pattern. The reader next starts to transmit a pulse. If no tag modulates the 0 modulation window of the pulse, the reader will deduce that no tag in the field has a 0 in the first bit position. In this case the reader would continue the pulse to include a 1 modulation window. Any tag in the field with a 1 in this position must start modulating in this window. In the instance of the first bit, if neither window is modulated the reader will know that there is no tag receiving in the field.

Assuming the first bit is modulated in the 0 modulation window (MW-0) and the reader stopped the pulse before the 1 modulation window, any tag with a 1 in this position will go quiescent until either a 'new sweep pattern' or a 'start search pattern' is received. The reader continues onto the second bit and so on until it gets to the last bit position and an individual tag has been uniquely identified. After a tag has been uniquely identified and eliminated the reader will start a new sweep with a 'new sweep pattern'.

In this fashion the reader will detect a 64 bit tag every 64 bit pulses (not including the

start search pattern and the 'new sweep patterns'). This is a highly efficient algorithm.

Referring to Figure 1, it will be seen that pulses A, B and C have all been modulated in the '0' modulation window (MW-0). This shows that there is at least one tag in the field which has a '0' as its first 3 bits.

In Figure 2, it will be seen that the first pulse (A) has been modulated by at least one tag which has a '0' in the first bit position. The second interrogating pulse (B) shows that no active tags have a '0' bit in this position and so the reader has continued the pulse to allow tags with a '1' bit in this position to respond by modulating the '1' modulation window. In this manner tags are progressively read and eliminated.

Modulation of the field referred to herein may be made by the dampening of the field by a circuit in each transponder tuned to the transmitter frequency.

CLAIMS

1. A Radio frequency tag identification apparatus comprising a radio frequency modulation receiver/transmitter, an antenna array, a radio frequency transponder, an external data communication port and an energising source.

2. An apparatus as claimed in claim 1 capable of generating modulated radio frequency power for application to an antennae.

3. An apparatus as claimed in claim 2 including an inductive loop antennae that will convert the electric power into an electric field to communicate with transponders and in some cases provide the power for the transponders where this power is not derived internally within the transponder from internal batteries or a light cell.

4. An apparatus as claimed in claim 2 including an antenna that will convert the electric power into an RF field to communicate with transponders.

5. An apparatus within the reader as claimed in claim 1 that determines the nature of the modulation according to claim 2 based on the logical outcome of previous communications with tags to conduct a binary search.

6. An apparatus within the reader as claimed in claim 1 that detects the modulation impressed on the field by any transponder comprising a demodulator and an amplifier, wherein the modulation signal is sent to a microprocessor in the logic block and is

digitised within the logic processor and evaluated.

7. An apparatus as claimed in claim 1 that communicates with external devises by means of an electrical interface.

8. An apparatus as in claim 1, the radio frequency transponder, which may be remotely interrogated by an electric field to disclose a bit sequence programmed into its memory and which may be capable of writing to its bit memory to change its value upon command.

9. An apparatus as claimed in claim 8, the radio frequency transponder consisting of a pickup coil, a rectifier and limiter with hysteresis, a clock extractor, a data extractor, a modulator and a logic section.

10. A radio frequency tag identification system comprising a receiver/transmitter and n transponders which are adapted to start communication at the same time and to be simultaneously interrogated and progressively eliminated from interrogation.

11. A radio frequency tag identification system or apparatus substantially as herein described and with reference to the accompanying drawings.

Abstract

Anti-Collision Tag Apparatus and System

This invention relates to radio frequency identification (RFID) apparatus comprising a reader/writer and transponders (tags) such that 2 or more transponders are capable of operating simultaneously in the same field so that information in the form of data bits may be received from the tags without corruption.

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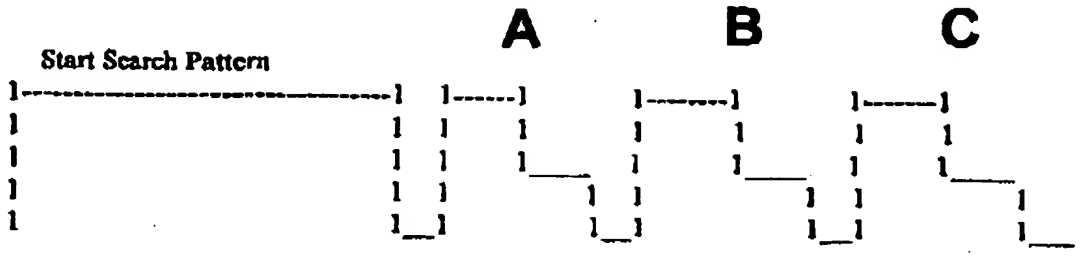

Fig 1

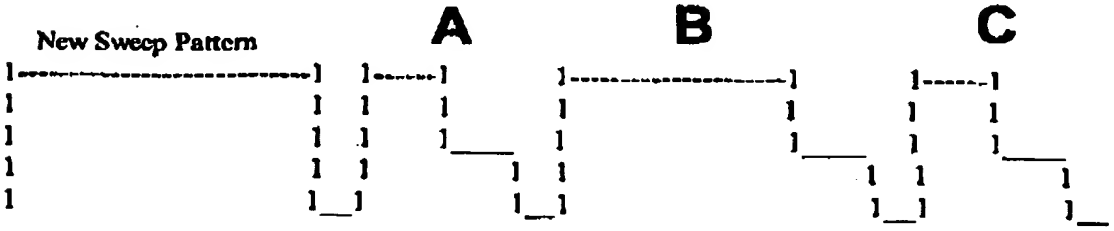

Fig 2

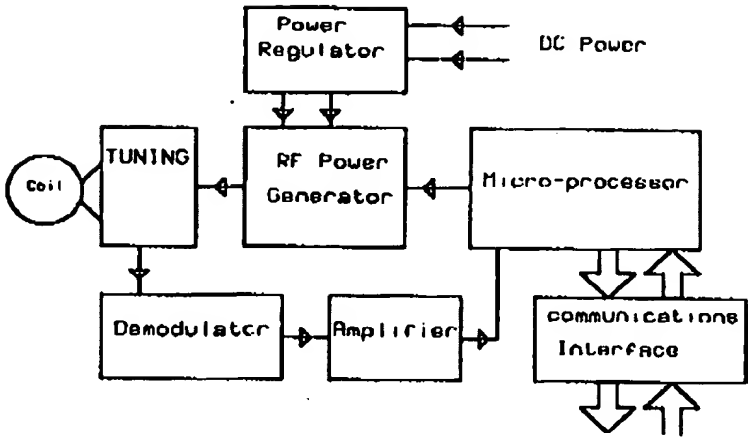
Power Regulator
DC Power
TUNING
Coil
RF Power Generator
Micro-processor
Demodulator
Amplifier
communications Interface

Fig 3

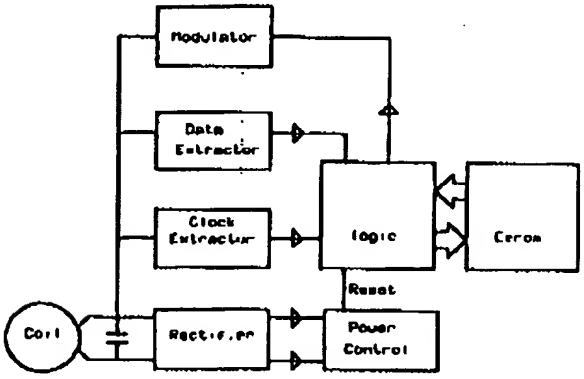
Modulator
Data Extractor
Clock Extractor
logic
Ceram
Reset
Coil
Rectifier
Power Control

Fig 4